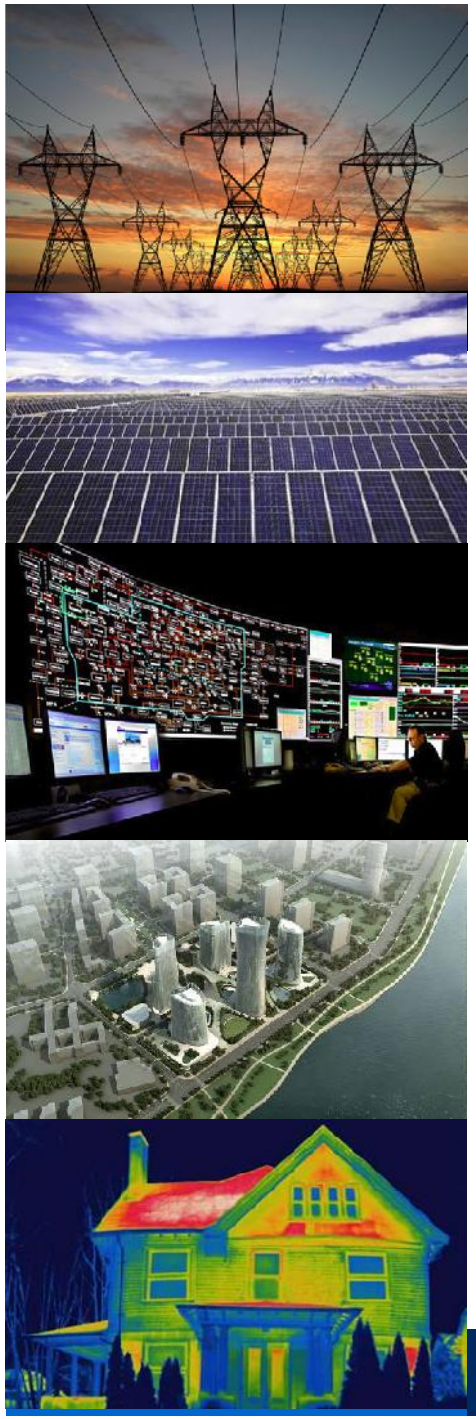


Value of Smart Grid Analytics for Exelon

March 1, 2013

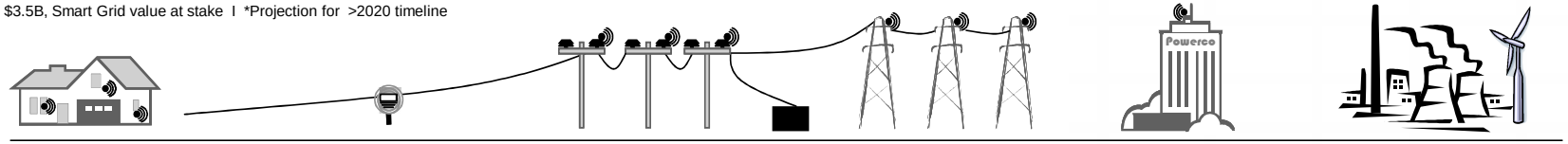
McKinsey&Company

C3 Grid Analytics: Value to top 10 US Utilities

C3 Grid Analytics

Demand side management					AMI	Distribution & transmission automation						Renewables support
$3.5B					$1.6B	$6.4B						$700M
Demand response	Energy efficiency / conservation	EV support	Distributed storage support*	Distributed gen support*	AMI	Condition-based mainten-ance	Fault detection / isolation restoration	CVR and volt-VAR optimization	DLR	Substation automation	WAM/ Tele-protection	Renewable energy resource support*
$330M	$2B		$590M	$590M	$1.6B	$250M	$1.9B	$2.7B	$380M	$370M	$50M	$700M

$3.5B, Smart Grid value at stake I *Projection for >2020 timeline



Technology

End-customer (e.g., EV chargers)	Smart meters	Distribution (e.g., reclosers)	Transmission (e.g., PMUs)	Market operations/trading	Generation (e.g., auto generation control)
Premise area network	Smart meter communications	Pole top routers	Substation routers & switches		
Residential Commercial Enterprise	CIS MDM DRM	OMS DMS	OMS EMS	Market Ops TRM	Generation Ops TRM

Business Process

Customer	Retail	Distribution	Transmission	Market operations/trading	Generation
Premise energy mgmt	New customer	New connection	New connections	Origination	Operations
EV charging	Meter to cash	Outage mgmt.	Outage mgmt.	Asset optimization	Maintenance
Distributed generation	Customer care	Capacity upgrade	Capacity upgrade	Ancillary services	Capital investments
Payments	Customer disconnect	System operations	System operations	Proprietary trading	Fuel procurement
	Demand side mgmt	Maintenance	Maintenance	Balancing / system ops	

Internal & external context

Regulatory		Market forces				Operational forces		
Market rules & Structure	Rate mechanism	Demand patterns	Fuel price	Renewables / CO2 policy	EV demand	Workforce productivity	Capacity requirements	Safety, Csat, Reliability gaps

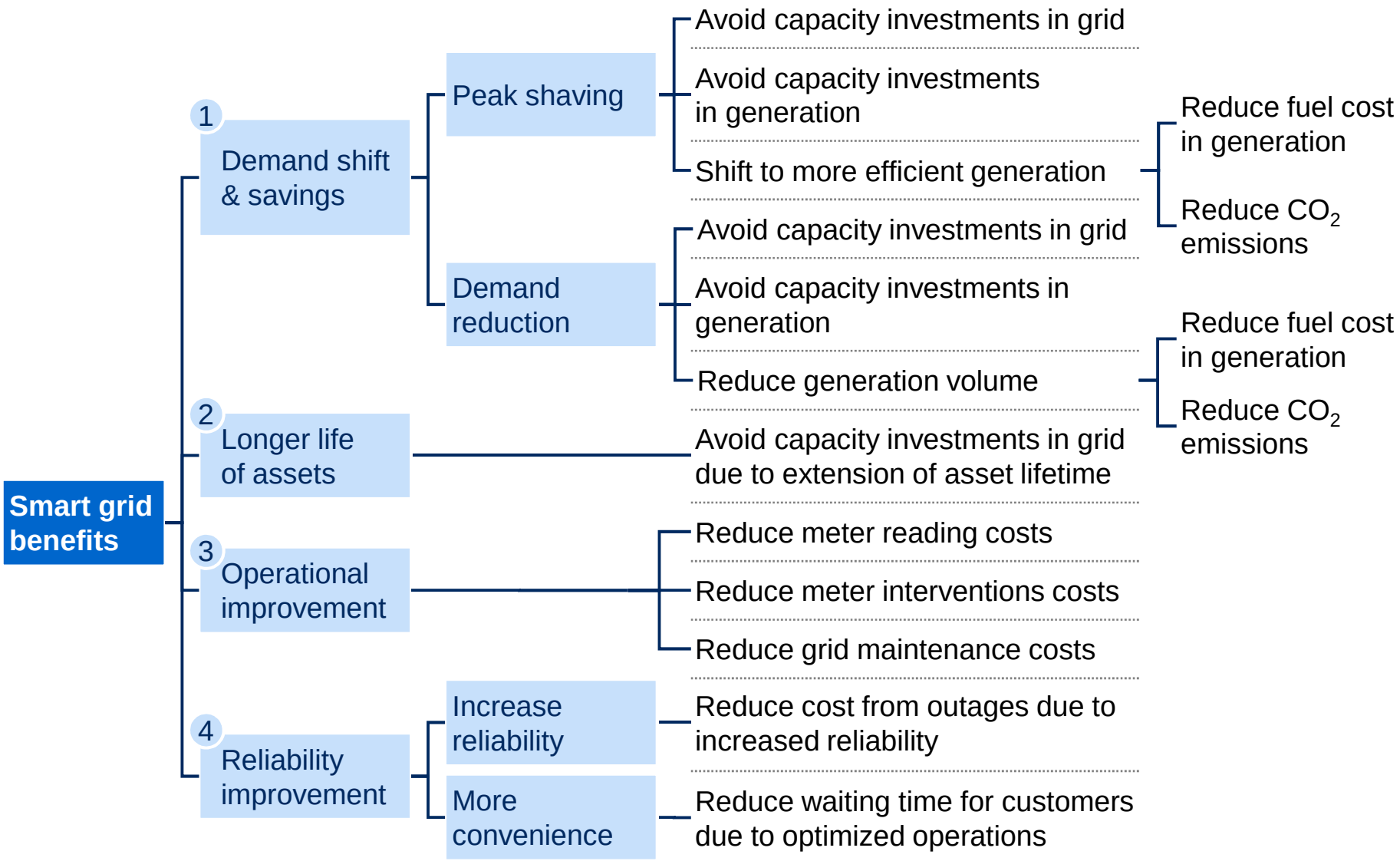
Business case

Society			Customer		Utility						
Environment	Economic Productivity	Jobs	Rates / Bills	Reliability / Quality	+/- Capex	+/- Opex	Revenue	Risk reduction	Safety / Security	Customer satisfaction	Reliability / Quality

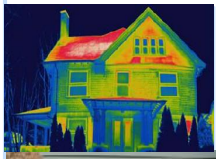
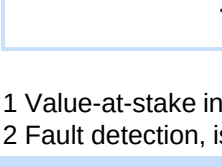
Value at stake

Security

Smart grids enable 4 major group of benefits



The total value-at-stake[1] for smart grid applications can be upwards of $240 per customer per year — the challenge is software/hardware integration

	Smart grid application	Description
	Distributed storage / EV	Facilitating Installation of grid-connected energy storage in the low-voltage network & support for electric vehicles
	Demand response	Programs and rates designed to allow customers to optimize their energy usage and receive incentives to shift their demand
	AMI	Deployment of smart meters with capabilities for automated meter reading, remote disconnect, outage notification, and theft reduction
	CVR[3] / Volt VAR Control	Installation of control and monitoring systems for capacitor banks, tap changers and voltage regulators to flatten and lower voltage levels to reduce consumption
	FDIR[2] / FLISR	Integration of feeder communications, reclosers/switches and a Distirbution Management System (DMS) to automate detection and isolation of faults
	Feeder condition based maintenance	Deployment of feeder sensors (excluding substation) to monitor, diagnose, and communicate critical information about asset condition
	Substation automation	Installation of communications, control, and metering equipment at substations to enable condition-based maintenance, remote switching & equipment monitoring
	Teleprotection / WAM	Installation of sensors on transmission lines to remotely monitor line condition to increase usable capacity while maintaining stability
	Dynamic line rating	Deployment of phasor measurement units (PMUs) in the transmission system for wide area monitoring (WAM) to detect abnormal conditions & take remedial action
	Total	**~$243 / customer value at stake**

1 Value-at-stake includes generator, utility, and customer value
2 Fault detection, isolation, and recovery / Fault location, isolation, and service restoration
3 Conservation voltage reduction

SOURCE: McKinsey analysis, Ventyx Energy Velocity

The total smart grid value-at-stake by customer, top targeted utilities, total US value, and global value

Applications with highest value

	Smart grid application	Value per customer[1] US$ / year	10 top utilities value US$M / year	U.S. estimated value US$B / year	Global estimated value US$B / year
Customer analytics	Demand side management	Electric vehicle support	6	70[4]	NA[4]	NA[4]
		Demand response	10	330	<2	10
	AMI	Advanced metering infrastructure (AMI)	52	1,560	9	55
Grid analytics	Transmission & distribution automation	CVR / Volt VAR Control[2]	76	2,650	13	80
		FDIR / FLISR[3]	63	1,880	11	70
		Feeder condition based maintenance	9	250	<2	10
		Substation automation	12	370	2	15
		Teleprotection / WAM	2	50	<1	<5
		Dynamic line rating	13	380	2	15
	Total		**$243 per customer / yr**	**$7.5B / yr**	**~$40B / yr**	**~$250B / yr**

1 Total average value-at-stake, per year; includes total value for all stakeholders (generator, utility, customer), calculated for a representative California utility
2 CVR: Conservation voltage reduction, VAR: Volt Ampere Reactive
3 FDIR: Fault detection, isolation, & recovery, FLISR: Fault location, isolation, & service restoration
4 EV value modeled for California only

SOURCE: McKinsey analysis

Up to $60/meter annual value to Exelon from a C3 Energy AMI analytics solution

Solutions	Benefits	Value drivers	Value to Exelon $ / smart meter / year
C3 Energy Revenue Protection	▪ Reduces unbilled energy due to theft and faulty meters	▪ ~1% of power consumption from theft / faulty meters would be reduced by 50%	9.6
C3 Energy Outage Analysis, Prediction, and Restoration	▪ Improves reliability and reduces operational expense by predicting and avoiding outages and optimizing outage restoration activities	▪ ~10% improvement in reliability ▪ Associated reduction in outage operational expense and improved CSAT	22.6
C3 Energy Asset Lifecycle Analytics	▪ Minimizes operational and capital expenditures through targeted monitoring and proactive maintenance of distribution network assets	▪ 3% capital savings and $0.60/meter opex savings ▪ More efficient assets reduce generation opex 0.2%	7.5
C3 Energy Customer Segmentation and Targeting	▪ Improves customer acquisition, retention, and satisfaction by targeting customers to offer tailored products and services	▪ 2% additional reduction in peak power, 1% reduction in peak demand and overall consumption ▪ Improved CSAT	10.0
C3 Energy Voltage Optimization - AMI	▪ Reduces opex and capex by lowering/right-sizing voltage across network	▪ 1 volt reduction in average feeder voltage reduces expenses 0.6%	10.2

Significant value to Exelon in an AMI solution

C3 Energy Products	Functionality	Annual Value to Exelon
C3 Energy Revenue Protection Reduces unbilled energy by detecting tampered, bypassed, and malfunctioning meters.	Applies sophisticated analytics on consolidated data from multiple utility systems to identify suspicious energy usage, assign likelihood of non-technical loss, and estimate revenue loss at stake.	**$75 million** $9.60/meter
C3 Energy Outage Analysis, Prediction, and Restoration Improves reliability and reduces operational expense by providing analysis of ongoing grid operations and outage events, predicting and avoiding outages due to equipment and asset failure, and enabling enhanced preparation for and response to both equipment-related and weather-related outages.	Optimizes outage response activities by coupling real-time AMI data with historical outage pattern information. Integrates AMI data with OMS, WAM, GIS, and CIS data systems to proactively identify and address assets at risk of failure.	**$176 million** $22.60/meter
C3 Energy Asset Lifecycle Analytics Minimizes both operational and capital expenditures through targeted monitoring of distribution network assets and the proactive determination and scheduling of maintenance or replacement.	Monitors, detects, and diagnoses distribution asset parameters (dynamic loading, capacity optimization, and voltage abnormalities) in real-time.	**$59 million** $7.50/meter
C3 Energy Customer Segmentation and Targeting Improves customer acquisition, retention, and satisfaction by segmenting and targeting customers in order to offer products and services uniquely tailored to meet their requirements.	Analyzes energy usage patterns from AMI data in combination with customer characteristic information to correlate micro-customer segments, product offerings, prices, and rates.	**$78 million** $10.00/meter
C3 Energy AMI Voltage Optimization Reduces operational expense by reducing voltage variations across the distribution network, and lowering/right sizing voltage at feeder sources**.**	Uses AMI data, utility distribution topology, outage management systems, and documented engineering constraints to identify the most inefficient feeders, estimate financial savings associated with voltage reduction, and provide feeder remediation recommendations	**$80million** $10.20/meter
	TOTAL	**$468 million**

Significant value to Exelon in an AMI solution

C3 Energy Products	Value Drivers	Annual Value to Exelon
C3 Energy Revenue Protection	1) Increased revenue due to reduction in theft, assuming 1% rate of theft and 50% reduction in theft = $9.60/meter	**$75 million** $9.60/meter
C3 Energy Outage Analysis, Prediction, and Restoration	1) Improvement in reliability (SAIDI, SAIFI), assuming 25% reduction in equipment failure outages and 5% improvement in weather outage response = $21.20/meter 2) Reduction in operational expenses assuming 25% reduction in equipment failure outages, which average $1250 per outage in operational expense = $0.70/meter 3) Improvement in customer satisfaction assuming marketing spend savings = $0.60/meter 4) Increased revenue due to fewer outages = $0.10/meter	**$176 million** $22.60/meter
C3 Energy Asset Lifecycle Analytics	1) Better asset maintenance targeting and longer asset life, leading to 3% capital savings per year on distribution network assets = $4.80/meter 2) Reduction in opex due to reduced asset inefficiency (0.2% lower generation costs) = 2.10/meter 2) Reduction in opex, assuming $0.60 saving per endpoint per year due to less manual asset inspections = $.60/meter	**$59 million** $7.50/meter
C3 Energy Customer Segmentation and Targeting	1) Reduction in peak power consumption resulting in lower generation expenses (due to 20% increase in DR penetration) = $7.50/meter 2) Lower generation opex expenses (e.g., fuel) assuming a 1% reduction in peak demand (half shifted, half curtailed) = $1.40/meter 3) Improvement in customer satisfaction by targeting specific customers for DR, assuming marketing spend savings = $1.10/meter	**$78 million** $10.00/meter
C3 Energy AMI Voltage Optimization	1) Reduction of additional generation opex, assuming demand reduction due to average system-wide reduction in voltage of approximately 1.0V= $7.20/meter 2) Lower generation capex expenses assuming a 0.6% reduction in peak power = $3.00/meter	**$80million** $10.20/meter
	TOTAL	**$468 million**

Significant value to Exelon Utilities in an AMI solution

$ Millions per year

	Exelon	BGE	PECO	ComEd
Revenue Protection	**75**	24	19	32
Outage Analysis and Prediction	**176**	45	42	89
Customer Segmentation and Targeting	**78**	22	19	37
Asset Lifecycle Management	**59**	16	15	28
Voltage Optimization	**80**	24	21	35
TOTAL	**468**	**131**	**116**	**221**